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(54) FLUIDIC CABIN TEMPERATURE CONTROL SYSTEM

(71) We, NORMALAIR-GARRETT (HOLDINGS) LIMITED, of Westland Works, Yeovil, in the County of Somerset, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of controlling temperature in conjunction with deicing and air conditioning, and comprises temperature selector means, temperature sensor means, manual override means and valve means controlled by, or controlling fluid amplifier signals. Hitherto, temperature control has been performed utilising electrical sensors and controls which necessitate two separate power supplies, electrical and pneumatic, whereas this invention requires no electrical controls or sensors.

According to the invention there is provided a fluidic control means for a cabin temperature control system comprising:—

(a) a pressurised fluid supply

(b) fluidic amplifier means providing regulated output for control of system valve means

(c) a cabin temperature sensor operative upon said fluidic amplifier means

(d) selectable temperature control means operative upon said fluidic amplifier means in opposed relationship to said cabin temperature sensor.

(e) manual override means operative upon said fluidic amplifier means to divert said output to a predetermined outlet

(f) modulation means providing regulation of said diversion of said override means.

As a further feature of the invention there is provided a fluidic control means for a cabin temperature control system having anticipator means for controlling rate of change of temperature and/or a maximum temperature override control means.

As a still further feature of this invention there is provided a fluidic control means for a cabin temperature control system having temperature sensor means including a flow inducer wherein temperature sensitive means exposed to ambient fluid flowing through said inducer controls fluidic flow through a port, said fluidic flow being at least part of fluidic flow controlling said fluidic temperature control system.

One embodiment of the invention will be described with reference to the appended drawings, in which:—

Figure 1 discloses a fluidic temperature control system for an aircraft cabin,

Figure 2 discloses a circuit diagram of the control system, and

Figure 3 discloses a cabin temperature sensor for a fluidic system.

Figure 1 shows a fluidic temperature control system for an aircraft cabin in which 1 is an air supply pack, in this case also subject to a fluidic cabin pressure control system, and capable of supplying both systems.

The system includes a temperature control valve 2, a hot air duct 3, a filter 4, a power relay 5, a cabin temperature sensor 6, crew member controls 7, 8 and 9, a temperature controller 10, air distribution ducting 11, an anticipator 12, a high limit sensor 13, a cabin inlet non-return valve 14, a water separator 15, an ice screen 16, an ice detector 17 and a cold air duct 18.

Referring to Figures 1, 2 and 3, the pressure supply 1 comprising a reducing valve 19, a by-pass valve 20 and a filter 21, supplies the power and controlling pressures for the system, terminating in the temperature control valve 2.

The bi-metallic cabin temperature sensor 6, located in a miniature wall attachment type ejector pump 22, through which the cabin air pressure passes via inlets 24 and outlet 25, senses variations in the cabin air temperature. These temperature variations altering the position of the bi-metallic sensor relative to control pressure line 23, thereby controlling the strength of a control jet 26 as biasing in amplifier A2 of the temperature controller 10.

A temperature control knob 9 operates a needle valve which vents pressure to atmos-

phere proportional to its degree of opening and when set to the required temperature, varies the pressure in bias line 37, which feeds control jet 27 as biasing of amplifier A2 of the temperature controller 10. As the two bias jets 26 and 27 are diametrically opposed the difference in pressure will determine the direction of a power jet from a valve 38, thereby determining which control jets in amplifiers A3 and A4 will predominate, and hence whether the power relay assembly 5 will open or close the temperature control valve 2.

A suitably lagged unimetal type anticipator probe 12 situated in the cabin inlet ducting generates a derivative signal which is a measure of the rate of change of duct temperature, an outer container 34 changing temperature faster than a lagged probe 33, causing a vent valve 30 to open or close. This variable signal, diametrically opposed to a fixed signal control jet in amplifier A5 determines the direction of flow of a power jet. The signal from outlet 40 in opposition to the pre-set signal from valve 36 controlling the output of amplifier A1. This amplifier permits setting adjustment of the signal gain before it is summed with the proportional output signal derived from the cabin temperature sensor 6, and its opposing bias from selector control valve 9.

A manual override control 7, a small spring-loaded toggle-operated valve, when actuated, applies a bias signal via bias line 41 to control jet 42 of amplifier A3, (part of temperature controller 10), overriding the signals from the automatic sensors 6 and 12 applied through amplifiers A_1 and A_2, thereby diverting the power jet in amplifier A_4 to a predetermined outlet which shuts the temperature control valve 2. Air delivered via the override control operated toggle-valve 7 also provides a signal to a control jet 43 on amplifier A4, (part of temperature controller 10) via line 44, which can be modulated as required by manipulation of a bias control needle valve 8, which permits pressure flow proportional to its degree of opening. Modulated control pressure from control jet 43 acting in opposition to the effect of control jet 42 on the power jet of amplifier A_4 allows manual control of the degree of opening of the temperature control valve 2.

A maximum temperature override control 13, comprising a pre-tensioned bi-metallic sensor 31 operating a valve 32 venting pressure via an outlet 29, operates on both automatic and manual control modes. Its action is to open a bleed between the output of the final stage amplifier A4 and the power relay 5, which opens, thus shutting the temperature control valve 2.

An anti-icing override, comprising ice screen 16 and a detector or probe 17, provides ice protection. The temperature control valve relay is vented via probe 17 to a point at the centre of the ice screen 16 in the cold air supply ducting just upstream of the water separator. Due to its position at the centre of the duct the probe ices up before serious icing of the system occurs, building up a back pressure in the control relay 5 vent line, opening the temperature control valve 2 and admitting hot air through ducting 3.

Control 28 is a variable bleed to cabin, and 39 is a noise attenuator.

WHAT WE CLAIM IS:—

1. A fluidic control means for a cabin temperature control system comprising:—
(a) a pressurised fluid supply
(b) fluidic amplifier means providing regulated output for control of system valve means
(c) a cabin temperature sensor operative upon said fluidic amplifier means
(d) selectable temperature control means operative upon said fluidic amplifier means in opposed relationship to said cabin temperature sensor
(e) manual override means operative upon said fluidic amplifier means to divert said output to a pre-determined outlet
(f) modulation means providing regulation of said diversion of said override means.

2. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein anticipator means are added for controlling rate of change of temperature.

3. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein maximum temperature override control means are added.

4. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein said fluidic amplifier means comprises one or more fluidic proportional amplifiers.

5. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein said selectable temperature control comprises a needle valve which vents pressure to atmosphere proportionate to the degree of opening.

6. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein said manual override means comprises a spring-loaded toggle-operated valve.

7. A fluidic control means for a cabin temperature control system as claimed in Claim 1, wherein said modulating means comprises a needle valve which permits pressure flow proportionate to degree of opening.

8. A fluidic control means for a cabin temperature control system as claimed in Claim 2, wherein said anticipator means comprises a unimetal lagged probe within an outer container, said probe controlling the degree of opening of valve means.

9. A fluidic control means for a cabin temperature control system as claimed in Claim 3, wherein said maximum temperature override control means comprises a pre-tensioned

bi-metallic sensor controlling valve means.

10. In a fluidic control means as claimed in Claim 1, temperature sensor means including a flow inducer wherein temperature sensitive means exposed to ambient fluid flowing through said inducer controls fluidic flow through a port, said fluidic flow being at least part of fluidic flow controlling said system.

11. A fluidic control means for a cabin temperature control system as hereinbefore described with reference to Figures 1 and 2 of the accompanying drawings.

12. A fluidic temperature sensor as claimed in Claim 10 and as hereinbefore described with reference to Figure 3 of the accompanying drawings.

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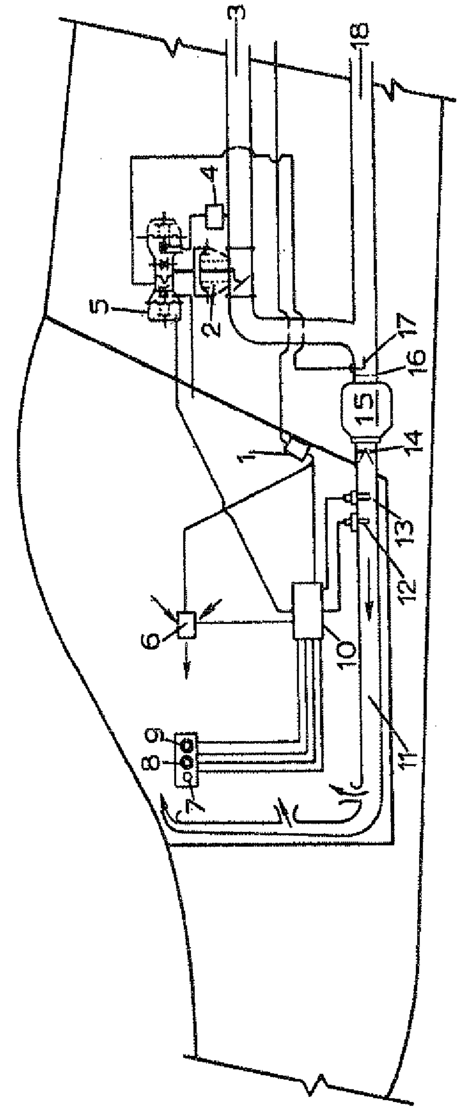

FIG.1

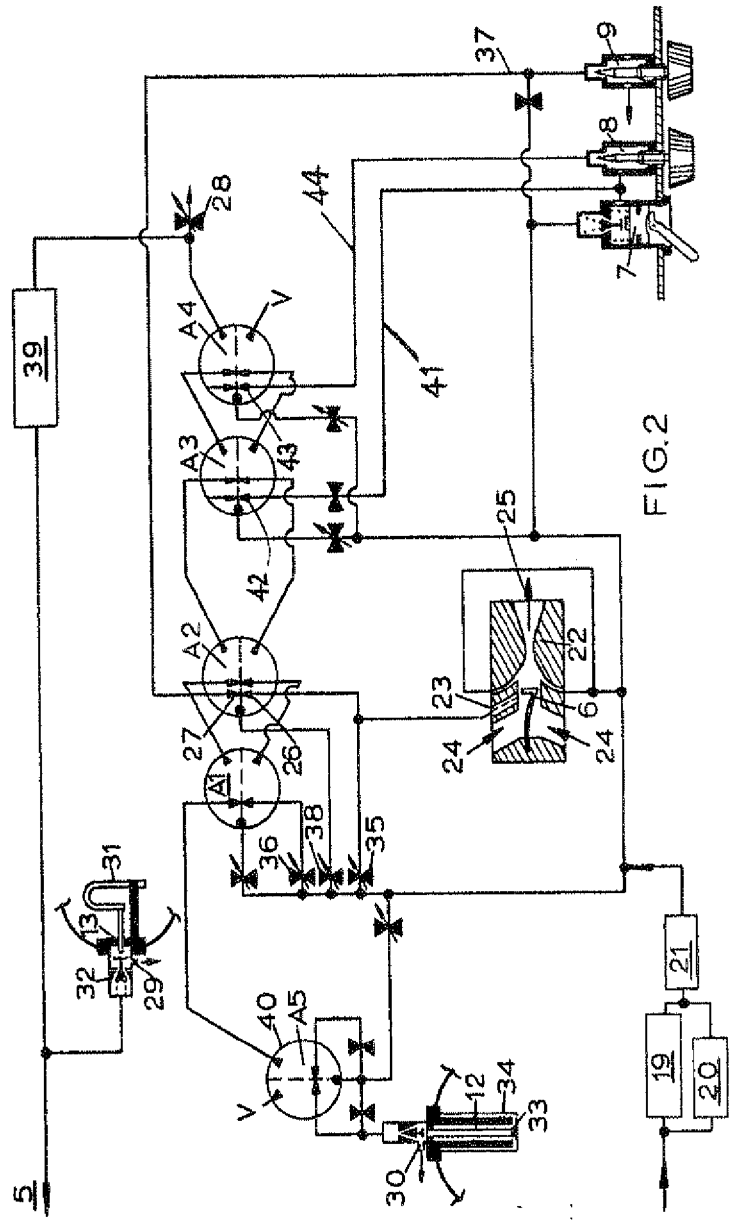
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FIG.2

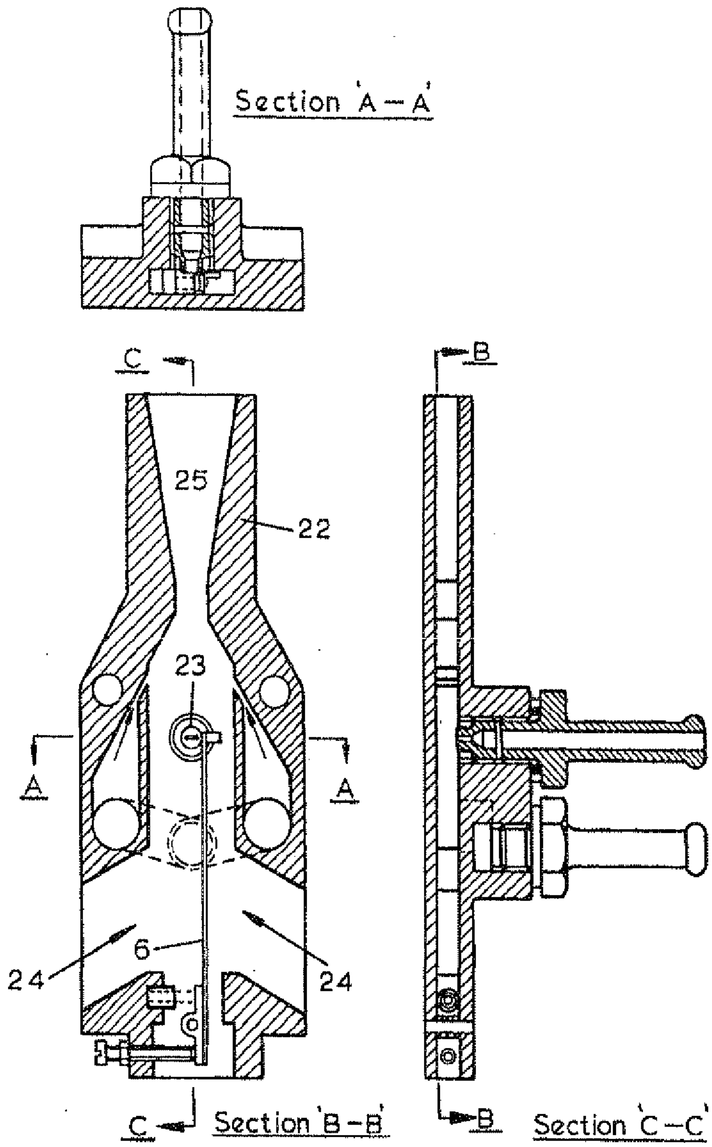

FIG.3